[0143] **CLAIMS**

[0144] We claim:

1. A fluid handling structure comprising an assembly of adhered metal layers, wherein a plurality of said adhered metal layers is patterned to include at least one shaped opening which passes through said metal layers, so that upon adherence of said plurality of layers a fluid handling structure is formed.

2. A fluid handling structure in accordance with Claim 1, wherein at least a portion of said adhered metal layers are adhered by diffusion bonding.

3. A fluid handling structure in accordance with Claim 1 or Claim 2, wherein at least a portion of said adhered metal layers are chemically or electrochemically etched to provide at least one shaped opening which passes through said metal layers.

4. A fluid handling structure in accordance with Claim 1 or Claim 2, wherein said plurality of metal layers comprise a metal selected from the group consisting of stainless steel, a corrosion-resistant nickel alloy, a corrosion-resistant cobalt alloy, and combinations thereof.

5. A fluid handling structure in accordance with Claim 3, wherein said plurality of metal layers comprise a metal selected from the group consisting of stainless steel, a corrosion-resistant nickel alloy, a corrosion-resistant cobalt alloy, and combinations thereof.

6. A fluid handling structure in accordance with Claim 4, wherein said plurality of metal layers includes a corrosion-resistant nickel alloy, and wherein said corrosion-resistant nickel alloy is a HASTELLOY®.

7. A fluid handling structure in accordance with Claim 4, wherein said plurality of metal layers includes a corrosion-resistant cobalt alloy, and wherein said corrosion-resistant cobalt alloy is an ELGILOY®.

8. A fluid handling structure in accordance with Claim 5, wherein said plurality of metal layers includes a corrosion-resistant nickel alloy, and wherein said corrosion-resistant nickel alloy is a HASTELLOY®.

9. A fluid handling structure in accordance with Claim 5, wherein said plurality of metal layers includes a corrosion-resistant cobalt alloy, and wherein said corrosion-resistant cobalt alloy is an ELGILOY®.

10. A fluid handling structure in accordance with Claim 2, wherein metal layers which are diffusion bonded have a thickness within the range of about 0.0005 inch to about 0.06 inch.

11. A fluid handling structure in accordance with Claim 10, wherein said thickness is within the range of about 0.003 inch to about 0.025 inch.

12. A fluid handling structure in accordance with Claim1, wherein said at least one shaped through-hole is aligned with a shaped through-hole in an adjacent layer, thereby forming a fluid flow channel in said plurality of metal layers.

13. A fluid handling structure in accordance with Claim 1, wherein at least one layer of said plurality of metal layers includes at least one through-hole which is adapted for mounting of at least one component device.

14. A fluid handling structure in accordance with Claim 1 or Claim 2, wherein said structure is part of a fluid distribution network for use in semiconductor processing.

15. A fluid handling structure in accordance with Claim 3, wherein said structure is part of a fluid distribution network for use in semiconductor processing.

16. A fluid handling structure in accordance with Claim 14, wherein said structure is a gas distribution structure for use in semiconductor processing.

17. A fluid handling structure in accordance with Claim 15, wherein said structure is a gas distribution structure for use in semiconductor processing.

18. A fluid handling structure in accordance with Claim 1 or Claim 2, wherein said fluid handling structure is an integrated part of a network architecture including a number of fluid handling component devices.

19. A fluid handling structure in accordance with Claim 3, wherein said fluid handling structure is an integrated part of a network architecture including a number of fluid handling component devices.

20. A fluid handling structure in accordance with Claim 18, wherein said fluid handling structure is an integrated part of a network including a combination of fluid flow channels and component devices, and wherein said component devices are at least partially integrated into a layered substrate.

21. A fluid handling structure in accordance with Claim 19, wherein said fluid handling structure is an integrated part of a network including a combination of fluid flow channels and component devices, and wherein said component devices are at least

partially integrated into a layered substrate.

22. A fluid distribution network architecture for use in semiconductor processing equipment, wherein said fluid distribution network architecture comprises a fluid handling structure including a plurality of metal layers which have been diffusion bonded together, and wherein said plurality of metal layers includes at least one feature which has been chemically or electrochemically etched through said layer prior to said diffusion bonding.

23. The fluid distribution network architecture of Claim 22, wherein said plurality of metal layers comprise a metal selected from the group consisting of stainless steel, a corrosion-resistant nickel alloy, a corrosion-resistant cobalt alloy, and combinations thereof.

24. The fluid distribution network architecture of Claim 23, wherein said plurality of metal layers includes at least one layer of a corrosion-resistant nickel alloy.

25. The fluid distribution network architecture of Claim 24, wherein said corrosion-resistant nickel alloy is HASTELLOY®.

26. The fluid distribution network of Claim 23, wherein said plurality of metal layers includes at least one layer of a corrosion-resistant cobalt alloy.

27. The fluid distribution network architecture of Claim 26, and wherein said corrosion-resistant cobalt alloy is ELGILOY®.

28. The fluid distribution network architecture of Claim 22, wherein said fluid handling structure , wherein said metal layers of said fluid handling structure which are

diffusion bonded have a thickness within the range of about 0.0005 inch to about 0.06 inch.

29. The fluid distribution network architecture of Claim 22, wherein at least a portion of said feature of said fluid handling structure is formed from a plurality of metal layers each of which includes a shaped through hole.

30. The fluid distribution network architecture of Claim 29, wherein a plurality of shaped through holes are aligned with a through hole in an adjacent layer, thereby forming a fluid flow channel.

31. The fluid distribution network architecture of Claim 22, wherein at least one layer of said plurality of metal layers includes at least one through hole which is adapted for mounting of at least one component.

32. The fluid distribution network architecture of Claim 31, wherein said at least one component device is selected from the group consisting of manually operated valves, automatic valves, combination manually operated/automatic valves, pressure and temperature sensors, pressure regulators, flow sensing devices, flow controllers, laminar flow devices, check valves, filters, and purifiers.

33. The fluid distribution network architecture of Claim 22, wherein said structure includes at least one component device and at least a portion of said component device is partially or fully integrated into and diffusion bonded with said plurality of metal layers.

34. The fluid distribution network architecture of Claim 33, wherein said at least one component device is selected from the group consisting of manually operated valves, automatic valves, combination manually operated/automatic valves, pressure and

temperature sensors, pressure regulators, flow sensing devices, flow controllers, laminar flow devices, check valves, filters, and purifiers.

35. The fluid distribution network architecture of Claim 22, wherein said network architecture includes a plurality of fluid handling structures.

36. The fluid distribution network architecture of Claim 35, wherein at least a portion of said fluid handling structures are fluid distribution assemblies attached to a manifold.

37. An on/off valve, wherein said on/off valve comprises:

a fluid-wetted section, including a lower body section and a diaphragm which, in combination, enclose other elements of said wetted section, wherein a fluid enters said lower body section through one or more inlet ports and exits through at least one exit port present in said lower body section, and wherein said exit port has, formed as part of or upon an inner lip thereof, an annular metallic valve seat, and wherein said valve is closed to flow of said process fluids when said diaphragm is pressed sufficiently tightly against said metallic valve seat;

a non-fluid-wetted drive section, including a sliding cylinder which comprises an upper horizontal member which is pressure sealed against a first upper body surface of said valve and a lower horizontal member, which is shorter than said upper horizontal member, which is pressure sealed against a second upper body surface of said valve so that a pneumatic chamber is formed between said upper horizontal member and said lower horizontal member, wherein said upper horizontal member is tied to said lower horizontal member, and wherein said sliding cylinder moves up and down above said diaphragm depending on the pneumatic force in said pneumatic chamber, whereby a surface of said lower horizontal member presses against said diaphragm at least periodically, wherein a spring pushes against a top surface of said upper horizontal

member and a controlled pneumatic force is applied in said pneumatic chamber, pushing against a bottom surface of said upper horizontal member, and wherein a balance between said spring and said pneumatic force determines an extent to which said valve is open to fluid flow.

38. A capacitance dual electrode pressure sensor in a layered substrate, said pressure sensor including a plurality of adhered metallic layers-comprising: an assembly of adhered layers which form a fluid flow channel, where said assembly is in contact with a layer which contains a plurality of openings which provide fluid contact with an overlying layer which includes a first chamber, which overlying layer is in contact with a diaphragm layer which is in contact with an overlying layer which includes a second chamber, which is in communication with an overlying electrically insulative disk having a pair of electrodes thereon and plurality of openings therein, said electrically insulative disk being in contact with a spacer, which is in contact with an overlying cap layer 728, whereby a third chamber is formed, wherein said third chamber is maintained at a reference pressure.

39. A capacitance dual electrode pressure sensor in accordance with Claim 38, wherein at least a portion of said adhered layers are diffusion bonded.

40. An in-line filter in a layered substrate, said in-line filter comprising a plurality of adhered layers, including a series of layers having shaped through holes etched therein, wherein a portion of said shaped through holes are positioned in an alignment which forms a cavity, wherein said cavity is filled with a sintered media which acts as a filtering agent, and wherein another portion of said shaped through holes provides an entry to and an exit from said in-line filter.

41. An in-line filter in a layered substrate in accordance with Claim 40, wherein at least a portion of said adhered layers are diffusion bonded.

42. A method of preparing a gas distribution assembly for use in semiconductor processing equipment, wherein said method comprises:

a) providing a plurality of metal layers;

b) chemically or electrochemically etching at least one feature through at least one of said metal layers;

c) aligning said plurality of metal layers; and

d) diffusion bonding said plurality of metal layers.

43. The method of Claim 42, wherein said plurality of metal layers comprise a metal selected from the group consisting of stainless steel, a corrosion-resistant nickel alloy, a corrosion-resistant cobalt alloy, and combinations thereof.

44. The method of Claim 43, wherein said plurality of metal layers includes a corrosion-resistant nickel alloy, and wherein said corrosion-resistant nickel alloy is HASTELLOY®.

45. The method of Claim 43, wherein said plurality of metal layers includes a corrosion-resistant cobalt alloy, and wherein said corrosion-resistant nickel alloy is ELGILOY®.

46. The method of Claim 42, wherein said metal layers to be diffusion bonded have a thickness within the range of about 0.0005 inch to about 0.06 inch.

47. The method of Claim 42, wherein said at least one feature includes a shaped through hole.

48. The method of Claim 47, wherein said shaped through hole is aligned with a

shaped through hole in an adjacent layer prior to diffusion bonding, thereby forming a gas flow channel in said plurality of metal layers after diffusion bonding.

49. The method of Claim 42, wherein at least one layer of said plurality of metal layers includes at least one shaped through hole which is adapted for mounting of at least one component.

50. The method of Claim 42, wherein said method includes aligning and diffusion bonding at least a portion of a component device into said plurality of metal layers.

51. The method of Claim 50, wherein said at least one component device is selected from the group consisting of manually operated valves, automatic valves, pressure and temperature sensors, flow controllers, filters, pressure regulators, check valves, metering valves, needle valves, and purifiers.

52. The method of Claim 43, wherein each of said metal layers is 400 series stainless steel, and wherein diffusion bonding is performed at a temperature within the range of about 1000°C to about 1300°C, at a pressure within the range of about 3000 psi to about 5000 psi, for a time period within the range of about 3 hours to about 6 hours.

53. The method of Claim 43, wherein each of said metal layers is HASTELLOY® C-22, and wherein diffusion bonding is performed at a temperature within the range of about 1000°C to about 1300°C, at a pressure within the range of about 8000 psi to about 10,000 psi, for a time period within the range of about 3 hours to about 6 hours.

54. The method of Claim 43, wherein at least one of said metal layers is 400 series stainless steel, and at least one of said metal layers is HASTELLOY® C-22, and wherein diffusion bonding is performed at a temperature within the range of about 1000°C to

about 1300°C, at a pressure within the range of about 4000 psi to about 10,000 psi, for a time period within the range of about 3 hours to about 6 hours.

55. The method of Claim 43, wherein at least one of said metal layers is 400 series stainless steel, and at least one of said metal layers is ELGILOY®, and wherein diffusion bonding is performed at a temperature within the range of about 1000°C to about 1300°C, at a pressure within the range of about 4000 psi to about 10,000 psi, for a time period within the range of about 3 hours to about 6 hours.

56. A method of increasing the etchability of a metal which has a microstructure which is resistant to chemical etching, comprising:

a) heating said metal to a temperature within the range of about 1800°F to about 2000°F for a time period within the range of about 25 minutes to about 35 minutes;

b) chemically or electrochemically etching said metal;

c) heating said metal to a temperature of greater than about 2100°F for a time period of at least 30 minutes; and

d) cooling said metal to a temperature of less than about 300°F in a time period of less than about 5 minutes.

57. The method of Claim 56, wherein said metal is a metal alloy which comprises within the range of about 43 to about 71 weight % nickel, and within the range of about 1 to about 30 weight % chromium.

58. The method of Claim 57, wherein said metal alloy is selected from the group consisting of HASTELLOY® B-2, HASTELLOY® B-3, HASTELLOY® C-4, HASTELLOY® C-22, HASTELLOY® C-2000, HASTELLOY® C-276, HASTELLOY® G-30, and HASTELLOY® N.

59. The method of Claim 58, wherein said metal alloy is HASTELLOY® C-22.

60. The method of Claim 56, wherein said metal is heated to a temperature within the range of about 1825°F to about 1975°F in step a).

61. The method of Claim 56, wherein said metal is heated to a temperature within the range of about 2100°F to about 2200°F in step c).

62. The method of Claim 56, wherein said metal is cooled to a temperature within the range of about 200°C to about 300°C in step d).

63. The method of Claim 56, wherein said step c) heat treatment of said metal is performed concurrently with diffusion bonding of a first layer of said metal to a second layer of said metal.

64. A method for attaching a semiconductor processing chamber component to a semiconductor processing chamber, wherein said method comprises diffusion bonding said semiconductor processing chamber component to said semiconductor processing chamber.

65. The method of Claim 64, wherein said semiconductor processing chamber component is a gas distribution assembly.

66. The method of Claim 64, wherein said semiconductor processing chamber component is a component device selected from the group consisting of manually operated valves, automatic valves, pressure and temperature sensors, flow controllers, filters, pressure regulators, check valves, metering valves, needle valves, and purifiers.

67. The method of Claim 64, wherein said semiconductor processing chamber is selected from the group consisting of an etch chamber, a chemical vapor deposition (CVD) chamber, and a physical vapor deposition (PVD) chamber.

68. A method of improving the corrosion resistance of a stainless steel surface comprising: a) cleaning said stainless steel surface with a detergent or a basic reagent or a combination thereof, followed by;

b) further cleaning said stainless steel surface using deionized water, followed by;

c) drying said stainless steel surface using hot nitrogen gas, followed by;

d) inspecting said cleaned stainless steel surface and repeating steps a) through c) until said stainless steel surface meets a criteria for surface contamination, followed by;

e) treating said stainless steel with a nitric acid solution to improve the surface composition of said stainless steel, followed by;

f) further cleaning said stainless steel surface using deionized water, followed by;

g) treating said stainless steel surface with a detergent, followed by;

h) further cleaning said stainless steel surface using deionized water, followed by;

I) treating said stainless steel with a solution of citric acid to improve the surface composition of said stainless steel, followed by;

j) further cleaning said stainless steel surface using deionized water, followed by;

k) drying said stainless steel surface in the presence of an argon atmosphere, followed by;

l) heat treating said stainless steel surface in the present of an argon

atmosphere, followed by;

m) treating said stainless steel with a nitric acid solution to improve the surface composition of said stainless steel, followed by;

n) further cleaning said stainless steel surface using deionized water; and

o) drying said stainless steel surface using hot nitrogen gas.